

FORM PTO-1390
(REV. 12-2001)

U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

ATTORNEY'S DOCKET NUMBER

**TRANSMITTAL LETTER TO THE UNITED STATES
DESIGNATED/ELECTED OFFICE (DO/EO/US)
CONCERNING A FILING UNDER 35 U.S.C. 371**

2308/300

U.S. APPLICATION NO. (If known, see 37 CFR 1.5

10/088152

INTERNATIONAL APPLICATION NO.
PCT/GB00/03538

INTERNATIONAL FILING DATE
14 September 2000 (14.09.00)

PRIORITY DATE CLAIMED
14 September 1999 (14.09.99)

TITLE OF INVENTION
FILTRATION MEDIA AND THE MANUFACTURE THEREOF

APPLICANT(S) FOR DO/EO/US RUSSELL, Stephen John; HAMPSHAW, Eric and RATHOD, Manoj K. C.

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.
4. ☒ The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
 - a. ☐ is attached hereto (required only if not communicated by the International Bureau).
 - b. ☒ has been communicated by the International Bureau.
 - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☐ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
 - a. ☐ is attached hereto.
 - b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
 - a. ☐ are attached hereto (required only if not communicated by the International Bureau).
 - b. ☐ have been communicated by the International Bureau.
 - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
 - d. ☒ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371 (c)(3)).
9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ An English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11 to 20 below concern document(s) or information included:

11. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☐ A **FIRST** preliminary amendment.
14. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
15. ☐ A substitute specification.
16. ☐ A change of power of attorney and/or address letter.
17. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
18. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
19. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).

20. ☒ Other items or information:

UNSIGNED Combined Declaration and Power of Attorney.

Preliminary Examination Report.

Preliminary Amendment based on the amendments attached to the Preliminary Examination Report.

U.S. APPLICATION NO. (if known) **107 088152** INTERNATIONAL APPLICATION NO. **PCT/GB00/03538** ATTORNEY'S DOCKET NUMBER **2308/300**

21. ☒ The following fees are submitted:

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1)-(5)):

Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO **\$1040.00**

International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO **\$890.00**

International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO **\$740.00**

International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) **\$710.00**

International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) **\$100.00**

ENTER APPROPRIATE BASIC FEE AMOUNT =

CALCULATIONS PTO USE ONLY

\$ 890.00

Surcharge of **\$130.00** for furnishing the oath or declaration later than ☐ 20 ☒ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).

\$ 130.00

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	
Total claims	28 - 20 =	8	x \$18.00	\$ 144.00
Independent claims	2 - 3 =	0	x \$84.00	\$ 0.00
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ \$280.00	\$ 0.00

TOTAL OF ABOVE CALCULATIONS =

\$ 1,164.00

☐ Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by 1/2.

\$ 0.00

SUBTOTAL =

\$ 1,164.00

Processing fee of **\$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(f)).

\$ 0.00

TOTAL NATIONAL FEE =

\$ 1,164.00

Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **\$40.00** per property +

\$ 0.00

TOTAL FEES ENCLOSED =

\$ 1,164.00

Amount to be refunded: \$
charged: \$

- a. ☒ A check in the amount of \$ 1,164.00 to cover the above fees is enclosed.
- b. ☐ Please charge my Deposit Account No. _____ in the amount of \$ _____ to cover the above fees. A duplicate copy of this sheet is enclosed.
- c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 14-1138 A duplicate copy of this sheet is enclosed.
- d. ☐ Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137 (a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

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SIGNATURE

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NAME

32,163

REGISTRATION NUMBER

Docket No: 2308/300

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants:	RUSSELL et al.)
U. S. Serial No:	To be assigned)
Filed:	Herewith)
PCT International Application No:	PCT/GB00/03538)
Filed:	14 September 2000)
Claiming Priority from Great Britain Application No:	9921534.5)
Priority Date:	14 September 1999)
For :	FILTRATION MEDIA AND THE MANUFACTURE THEREOF)

PRELIMINARY AMENDMENT

Commissioner of Patents
and Trademarks
Washington, D.C. 20231
BOX: PCT

Dear Sir:

Please amend the above-identified patent application as follows:

In the Claims:

Kindly amend claims 5, 6, 9, 10, 12, 14, 17, 20, 21, 23, 25, 26, and 28 as follows:

5. (Amended) A process as claimed in Claim 2, wherein during air-laying the fibres are dispersed in a moving air stream to form an air/fibre mixture.

6. (Amended) A process as claimed in Claim 1, wherein the fibres comprise a blend of fibres of two or more types of fibre.

9. (Amended) A process as claimed in Claim 7, wherein the blend further comprises a modacrylic copolymer comprising from 35 to 85 weight percent acrylonitrile units and having the balance made up substantially of other addition polymer-forming units, being halogenated hydrocarbon such as vinyl chloride or vinylidene chloride.

10. (Amended) A process as claimed in Claim 7, wherein the weight ratio of component (a) to component (b) is in the range 70:30 to 30:70.

12. (Amended) A process as claimed in Claim 7, wherein the linear density of the fibres in component (a) and component (b) is in the range 0.1 to 10dtex.

14. (Amended) A process as claimed in Claim 1, wherein the fibres have a diameter of 12 μ m or less.

17. (Amended) A filtration medium as claimed in Claim 15, wherein the web comprises a blend of fibres of two or more types of fibre.

20. (Amended) A filtration medium as claimed in Claim 18, wherein the blend further comprises a modacrylic copolymer comprising from 35 to 85 weight percent acrylonitrile units and having the balance made up substantially of other addition polymer-forming units, being halogenated hydrocarbon such as vinyl chloride or vinylidene chloride.

21. (Amended) A filtration medium as claimed in Claim 18, wherein in the weight ratio of component (a) to component (b) is in the range 70:30 to 30:70.

23. (Amended) A filtration medium as claimed in Claim 18, wherein the linear density of the fibres in component (a) and component (b) is in the range 0.1 to 10dtex.

25. (Amended) A filtration medium as claimed in Claim 15, wherein the fibres have a diameter of 12 μ m or less.

26. (Amended) A filtration medium as claimed in Claim 15, which has a weight of from 200g/m² to 1000g/m².

28. (Amended) A filtration medium as claimed in Claim 15, which comprises a blend of fibres selected from the group consisting of

a) Polyvinylchloride / Polypropylene;

- b) Polyvinylchloride / Modacrylic / Polypropylene;
- c) Polyvinylchloride / Polypropylene / Polyethylene; and
- d) Polyvinylchloride / Modacrylic / Polyethylene.

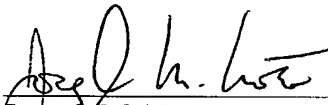
REMARKS

Entry of the foregoing prior to the initial office action on the merits is respectfully requested. Pursuant to 37 C.F.R. § 1.121, attached as Appendix A is a version with markings to show changes made to the claims. By the present Preliminary Amendment, claims 5, 6, 9, 10, 12, 14, 17, 20, 21, 23, 25, 26, and 28 have been amended, so that claims 1-28 remain pending.

Early allowance of the pending claims is hereby earnestly solicited.

Respectfully submitted,

Date: March 13, 2002



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APPENDIX A

Version With Markings to Show Changes Made

In reference to the amendments made herein to claims 5, 6, 9, 10, 12, 14, 17, 20, 21, 23, 25, 26, and 28 additions appear as underlined text, while deletions appear as bracketed text, as indicated below:

In The Claims:

5. (Amended) A process as claimed in [any one of Claims 2 to 4] Claim 2, wherein during air-laying the fibres are dispersed in a moving air stream to form an air/fibre mixture.

6. (Amended) A process as claimed in [any preceding claim] Claim 1, wherein the fibres comprise a blend of fibres of two or more types of fibre.

9. (Amended) A process as claimed in Claim 7 [or Claim 8], wherein the blend further comprises a modacrylic copolymer comprising from 35 to 85 weight percent acrylonitrile units and having the balance made up substantially of other addition polymer-forming units, being halogenated hydrocarbon such as vinyl chloride or vinylidene chloride.

10. (Amended) A process as claimed in [any one of Claims 7 to 9] Claim 7, wherein the weight ratio of component (a) to component (b) is in the range 70:30 to 30:70.

12. (Amended) A process as claimed in [any one of Claims 7 to 11] Claim 7, wherein the linear density of the fibres in component (a) and component (b) is in the range 0.1 to 10dtex.

14. (Amended) A process as claimed in [any preceding claim] Claim 1, wherein the fibres have a diameter of 12µm or less.

17. (Amended) A filtration medium as claimed in Claim 15 [or Claim 16], wherein the web comprises a blend of fibres of two or more types of fibre.

20. (Amended) A filtration medium as claimed in Claim 18 [or Claim 19], wherein the blend further comprises a modacrylic copolymer comprising from 35 to 85 weight percent acrylonitrile units and having the balance made up substantially of other addition polymer-forming units, being halogenated hydrocarbon such as vinyl chloride or vinylidene chloride.

21. (Amended) A filtration medium as claimed in [any one of Claims 18 to 20] Claim 18, wherein in the weight ratio of component (a) to component (b) is in the range 70:30 to 30:70.

23. (Amended) A filtration medium as claimed in [any one of Claims 18 to 22] Claim 18, wherein the linear density of the fibres in component (a) and component (b) is in the range 0.1 to 10dtex.

25. (Amended) A filtration medium as claimed in [any one of Claims 15 to 24] Claim 15, wherein the fibres have a diameter of 12 μ m or less.

26. (Amended) A filtration medium as claimed in [any one of Claims 15 to 25] Claim 15, which has a weight of from 200g/m² to 1000g/m².

28. (Amended) A filtration medium as claimed in [any one of Claims 15 to 27] Claim 15, which comprises a blend of fibres selected from the group consisting of

- a) Polyvinylchloride / Polypropylene;
- b) Polyvinylchloride / Modacrylic / Polypropylene;
- c) Polyvinylchloride / Polypropylene / Polyethylene; and
- d) Polyvinylchloride / Modacrylic / Polyethylene.

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FILTRATION MEDIA AND THE MANUFACTURE THEREOF

This invention relates to the manufacture of filtration media and in particular to the manufacture of electrostatic filtration media suitable *inter alia* for respiratory

5 filtration applications, and to novel filtration media produced thereby.

Filtration media are widely used in many applications, for example for the capture of airborne particles (bacteria, dust etc). In such filters it is desirable for the resistance to airflow to be low, without sacrificing the filtration efficiency (ie the effectiveness with which the filter captures the airborne particles). A known

10 measure intended to achieve these objectives is the creation of electrostatic charge on the filter material. Such a charge serves to attract the airborne material. One particular field of application of such electrostatically-charged filter media is respiratory filtration.

15 US 4,798,850 describes the formation of filter material with a felt structure composed of a blend of clean polypropylene fibres and clean fibres of an addition polymer comprising one or more halogen-substituted hydrocarbons. The felt is made by carding fibres into a web and needling them to form a coherent fabric

20 structure.

In the carding operation, fibres are worked by a series of toothed rollers, which serve to disentangle the fibre and provide some mixing to increase the homogeneity of the blend. The product from the carding machine is a continuous

25 web, which is peeled from the last main roller on the machine (doffer). The orientation of fibres in the web leaving the doffer is substantially dictated by the orientation of fibres leaving the doffer and is predominantly in the machine direction. In carding, the assembly of the web takes place mainly on the doffer and fibres are controlled by fibre to metal friction in the machine. The web is

30 subsequently layered to produce a so-called batt structure that is then mechanically bonded.

In general, it is desirable to be able to produce filtration media having satisfactory filtration efficiencies and low resistance to airflow, without having excessively high weight or thickness. It is also desirable to be able to achieve these objectives without having to resort to multi-layer structures in which the filtration medium is
5 laminated with, or bonded to, other material.

There has now been devised an improved method of forming non-woven filter materials which offers significant advantages over the prior art.

10 According to the invention, there is provided a process for the manufacture of a filtration medium, which process comprises air-laying fibres to form a non-woven web.

The process according to the invention is advantageous over the prior art in
15 several respects, including the following:

- (i) The fibre orientation in the web is more random (owing to the dispersion of loose fibres in air immediately before web formation). Web properties are consequently more isotropic.
- (ii) No carding step is required (as compared to the prior art) and consequently
20 the resulting structure does not consist of individual layers of web assembled one on top of the other. A single integrated structure is produced.
- (iii) The air-laid web structure can be characterised by pronounced orientation in the z-direction (or perpendicular to the web surface). This gives the structure higher bulk (for a given area density) than a carded web.
- 25 (iv) Using the sifting air-lay approach, fibres of 2-12mm can be converted into uniform web structures (in contrast to the prior art, which permits only lengths of typically 30-200mm to be processed (due to restrictions imposed by carding)).
- (v) A shorter web formation process is achieved as compared to carding.
- (vi) Providing it is clean, short, waste fibres (eg polypropylene) can be used in
30 the process assuming the length is at least 2mm. Such short fibres are incompatible with the carding process.

In the air-laying process, the manner of web formation is substantially different from the prior art and marked differences in fabric properties are obtained. In air-laying, fibres are transferred to either

- 5 (a) a rapidly rotating cylinder or roller clothed with teeth and interacting with either other toothed rollers or fixed carding plates or
- (b) a sifting screen or rotor device in which fibres are circulated over a mesh screen and then passed through an air-stream to form a web structure.

10

The former approach (roller-based air-laying) is presently preferred. In both processes, the mechanical working treatment is much shorter than that used in carding but is sufficient to electrostatically charge the fibre. In contrast to carding, the effect can be created solely at the site of interaction between the feed rollers and the opening roller. No further working points (eg worker rollers) are required. Electrostatic charging of the fibres is believed to be achieved as the fibres are separated between a set of feed rollers and a single rapidly rotating roller, or as they are contacted by the rotors and mesh yarns of the grid. Multiple rollers as used in carding are not required. In further contrast to carding, the charged fibres are then dispersed freely in a moving air stream to form an air/fibre mixture. The air then transports fibres from the rotating cylinder (or sifting area) to a suctioned mesh conveyor belt, screen or drum where the fibres are landed to form the web. The belt/drum acts as an air/fibre separator. The process is continuous and web weight depends on the speed of the landing drum or conveyor.

25

After web formation, consolidation of the web structure may be achieved using needle-punching.

30

The weight of the filtration media produced in accordance with the invention may be varied from approximately 200g/m² up to 1000g/m². For respiratory filter applications basis weights in the range 350-500g/m² would normally be selected.

To improve or modify performance characteristics (eg flow resistance, filtration efficiency, dimensional stability and fluid transmission) ready-made fabrics, scrims or films can be attached to fabrics produced in accordance with the invention.

- 5 As mentioned above, the properties of the web formed in the process according to the invention are more isotropic than in the prior art. This may manifest itself in a lower ratio of the tensile strengths of the web in the machine and cross directions (MD:CD), ie the longitudinal and transverse directions of the web as it is manufactured. Thus, according to a second aspect of the invention there is
- 10 provided a filtration medium comprising a non-woven web of fibrous material, said web having an MD:CD ratio of less than 2:1. More preferably, the MD:CD ratio is less than 1.5:1.

- 15 Preferably, a blend of two or more types of fibre is used in the process of the invention. Most preferably, the blend comprises (a) a polyolefin and (b) an addition polymer comprising one or more halogen-substituted hydrocarbons. The former component of the blend is preferably polypropylene and the latter may be, for instance, polyvinylchloride or polyvinylidene chloride.

- 20 The blend may contain other fibres, either alternatively or in addition to those mentioned above. Examples of other fibre types which may be included are polyethylene and "modacrylic", ie a copolymer comprising from 35 to 85 weight percent acrylonitrile units and preferably having the balance made up substantially of other addition polymer-forming units, being halogenated hydrocarbon such as
- 25 vinyl chloride or vinylidene chloride.

- The components of the blend may be present in any suitable proportions. Preferably, the weight ratio of (a):(b) is in the range 70:30 to 30:70. Most preferably, the two classes of fibre are present in approximately equal proportions
- 30 ie in each case between 45% and 55% by weight.

Preferably, the linear density of the two classes of the fibres in the blend is similar and is in the range 0.1 - 10 dtex (dtex = weight in grams of 10,000m of fibre).

Most preferably, the fibres are of less than 3.3 dtex. In terms of fibre diameter, the diameter is most preferably 12µm or less

The fibres are preferably substantially free from any fibre finishes, oils or other extraneous matter prior to blending. Such chemicals are ideally removed from the fibres by an aqueous scouring process using a solution containing a synthetic detergent, sodium carbonate or a potassium carbonate solution. Other scouring regimes may also be suitable. The scouring process should be followed by thorough rinsing and drying stages prior to further processing.

Likewise, all mechanical processing machinery must be thoroughly cleaned, preferably by chemical means, to remove all fibre finish, waxes, grease, anti-static agents or other chemical residues.

Currently preferred embodiments of the invention will now be described in greater detail, by way of illustration only, with reference to the accompanying drawings, in which

Figure 1 is a schematic diagram of a roller-based air-laying process; and

Figure 2 is a schematic diagram of a sifting-based air-laying process.

Roller-Based Air-Laying

Roller-based systems can take many forms. A basic embodiment is illustrated in Figure 1. In a roller-based air-laying process raw fibres are transferred first from a feed conveyor 11 to a clothed feed roller system 12 and then to a rapidly rotating cylinder 13 which is clothed with teeth and interacts with fixed carding elements 14, 15 or some other clothed surface (eg clothed rollers). Electrostatic charging of the fibres is achieved as the fibres are opened on the clothed cylinders 12, 13. An air knife 16 displaces fibres from the cylinder 13 on to a perforated conveyor 17 to which suction is applied from below. A non-woven web of fibre is built up on the

perforated conveyor 17 from which the web is drawn off and consolidated by needle-punching

Sifting-Based Air-Laying

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An example of a sifting-based air-laying process is illustrated in Figure 2. In such a process, loose fibre is contained within a drum 21 having a grid 22 at its base. Rotors 23 within the drum 21 displace fibres in an air stream on to the top surface of a perforated conveyor 24, to which suction is applied from below. Again, the non-woven web is built up on the conveyor from which it is drawn off and consolidated by needle-punching. Airflow in the system is constrained between a pair of rollers 25,26, the downstream one of which 26 also applies compression to the web. Other systems that use rotating rollers or brushes instead of a static grid and rotors may also be used.

15

Fibre Blends

Examples of fibre blends which may be used are:

- 20 a) Polyvinylchloride / Polypropylene
- b) Polyvinylchloride / Modacrylic / Polypropylene
- c) Polyvinylchloride / Polypropylene / Polyethylene
- 25 d) Polyvinylchloride / Modacrylic / Polyethylene

In each case, the proportion of PVC in the blend is approximately 50%. All the fibres have diameters of 12µm or less and lengths in the range 2 to 12mm.

30

Experimental results have indicated that the method of the invention provides marked performance benefits in the filter media compared to the prior art:

(i) Up to a 20% reduction in the weight of the fabric can be achieved whilst maintaining a bacterial filtration efficiency of at least 99.9997%.

(ii) Up to a 39% reduction in the resistance to flow can be achieved (compared to the existing art) whilst maintaining a bacterial filtration efficiency of at least 99.9997%.

(iii) Bacterial filtration efficiencies of at least 99.99997% can be achieved with a single layer air-laid structure. No laminated or incorporated layers (eg meltblown fabrics) are required.

Typical results (resistance to flow and filtration efficiency) for fabrics produced using the method of the invention (specifically, the roller-based air-laying approach) are given in Table 1. These samples were a 50:50 blend of polyvinylchloride and polypropylene.

Table 1

Typical Test Results for Air-Laid Media

Sample ref	Fabric weight (g/m ²)	Resistance to flow @60 l/min (cmH ₂ O)	Bacterial Filtration Efficiency (%)
2E	402	1.4	99.9997
6C	433	1.8	99.9994
4E	463	1.6	99.9998
6B	491	2.1	99.999
4B	529	1.8	99.999
7A	597	2.1	>99.999991

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- All tests were carried out on a pad of the respective fabric measuring 7.5x5.3cm and welded into a plastic housing with 22mm cylindrical inlet and outlet. Resistance to flow was measured in accordance with BS EN ISO 9360-1:2000. For bacterial efficiency, no standard currently exists. However, all products were
- 5 tested in accordance with the former draft standard prEN 13328-1 Part 1.

Claims

1. A process for the manufacture of a filtration medium, which process comprises
 - 5 a) transferring uncharged fibres to an air-laying apparatus;
 - b) air-laying the fibres onto a support so as to form an electrostatically-charged non-woven web in the form of a single layer; and
 - c) drawing the web from the support.
- 10 2. A process as claimed in Claim 1, wherein the air-laying apparatus comprises a rapidly rotating cylinder or roller clothed with teeth.
3. A process as claimed in Claim 2, wherein the rapidly rotating cylinder or roller clothed with teeth interacts with other toothed rollers or fixed carding plates.
- 15 4. A process as claimed in Claim 1, wherein the air-laying apparatus comprises a sifting screen or rotor device in which fibres are circulated over a mesh screen.
- 20 5. A process as claimed in any one of Claims 2 to 4, wherein during air-laying the fibres are dispersed in a moving air stream to form an air/fibre mixture.
6. A process as claimed in any preceding claim, wherein the fibres comprise a blend of fibres of two or more types of fibre.
- 25 7. A process as claimed in Claim 6, wherein the blend comprises comprises (a) a polyolefin and (b) an addition polymer comprising one or more halogen-substituted hydrocarbons.
- 30 8. A process as claimed in Claim 7, wherein component (a) is polypropylene and component (b) is polyvinylchloride and/or polyvinylidene chloride.

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9. A process as claimed in Claim 7 or Claim 8, wherein the blend further comprises a modacrylic copolymer comprising from 35 to 85 weight percent acrylonitrile units and having the balance made up substantially of other addition polymer-forming units, being halogenated hydrocarbon such as vinyl chloride or vinylidene chloride.
10. A process as claimed in any one of Claims 7 to 9, wherein the weight ratio of component (a) to component (b) is in the range 70:30 to 30:70.
11. A process as claimed in Claim 10, wherein the weight ratio of component (a) to component (b) is in the range 45:55 to 55:45.
12. A process as claimed in any one of Claims 7 to 11, wherein the linear density of the fibres in component (a) and component (b) is in the range 0.1 to 10dtex.
13. A process as claimed in Claim 12, wherein the linear density of the fibres is less than 3.3 dtex.
14. A process as claimed in any preceding claim, wherein the fibres have a diameter of 12µm or less.
15. A filtration medium consisting of a single layer of a non-woven web of fibrous material, said web having a ratio of the tensile strengths of the web in the machine and cross directions (MD:CD), ie the longitudinal and transverse directions of the web, of less than 2:1.
16. A filtration medium as claimed in Claim 15, wherein the MD:CD ratio is less than 1.5:1.
17. A filtration medium as claimed in Claim 15 or Claim 16, wherein the web comprises a blend of fibres of two or more types of fibre.

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18. A filtration medium as claimed in Claim 17, wherein the blend comprises (a) a polyolefin and (b) an addition polymer comprising one or more halogen-substituted hydrocarbons.

- 5 19. A filtration medium as claimed in Claim 18, wherein component (a) is polypropylene and component (b) is polyvinylchloride and/or polyvinylidene chloride.

- 10 20. A filtration medium as claimed in Claim 18 or Claim 19, wherein the blend further comprises a modacrylic copolymer comprising from 35 to 85 weight percent acrylonitrile units and having the balance made up substantially of other addition polymer-forming units, being halogenated hydrocarbon such as vinyl chloride or vinylidene chloride.

- 15 21. A filtration medium as claimed in any one of Claims 18 to 20, wherein the weight ratio of component (a) to component (b) is in the range 70:30 to 30:70.

- 20 22. A filtration medium as claimed in Claim 21, wherein the weight ratio of component (a) to component (b) is in the range 45:55 to 55:45.

23. A filtration medium as claimed in any one of Claims 18 to 22, wherein the linear density of the fibres in component (a) and component (b) is in the range 0.1 to 10dtex.

- 25 24. A filtration medium as claimed in Claim 23, wherein the linear density of the fibres is less than 3.3 dtex.

25. A filtration medium as claimed in any one of Claims 15 to 24, wherein the fibres have a diameter of 12µm or less.

- 30 26. A filtration medium as claimed in any one of Claims 15 to 25, which has a weight of from 200g/m² to 1000g/m².

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27. A filtration medium as claimed in Claim 26, wherein the medium has a weight of 350-500g/m².

28. A filtration medium as claimed in any one of Claims 15 to 27 which
5 comprises a blend of fibres selected from the group consisting of

- a) Polyvinylchloride / Polypropylene;
- b) Polyvinylchloride / Modacrylic / Polypropylene;
- c) Polyvinylchloride / Polypropylene / Polyethylene; and
- d) Polyvinylchloride / Modacrylic / Polyethylene.

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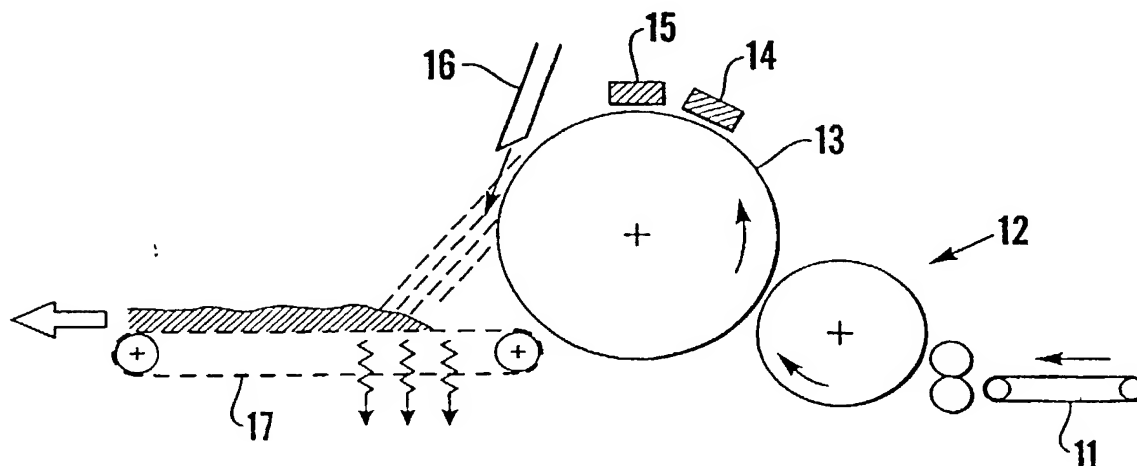


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- (54) Title: **FILTRATION MEDIA AND THE MANUFACTURE THEREOF**
- (81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.
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(57) Abstract: A process for the manufacture of a filtration medium comprises air-laying fibres to form a non-woven web. The process may be a roller-based air-laying process, in which raw fibres are transferred to a rapidly rotating cylinder or roller clothed with teeth, or a sifting-based air-laying process in which the fibres are circulated over a mesh screen. In either case, the fibres are dispersed in a moving air stream and deposited to form the non-woven web. Filtration media produced in accordance with the invention are electrostatically charged and are characterized by a high degree of isotropicity.

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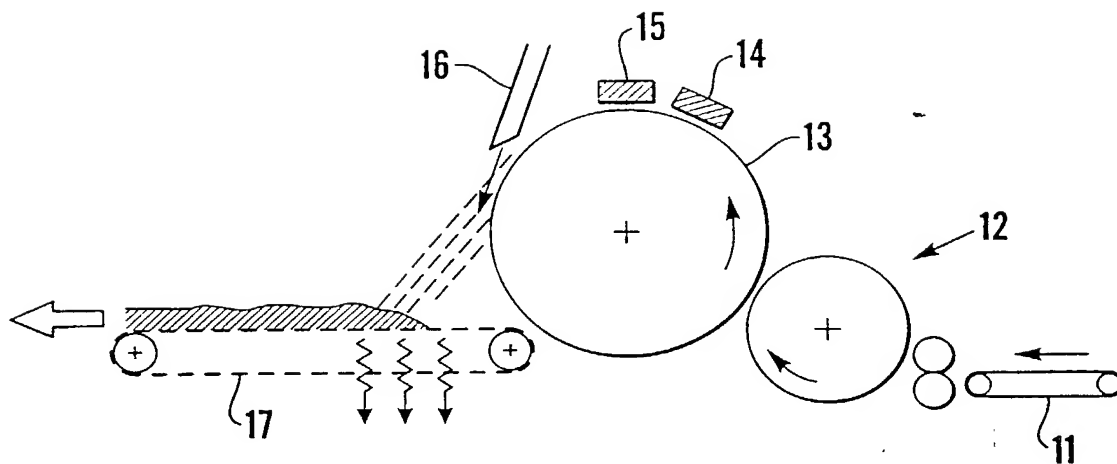


Fig. 1

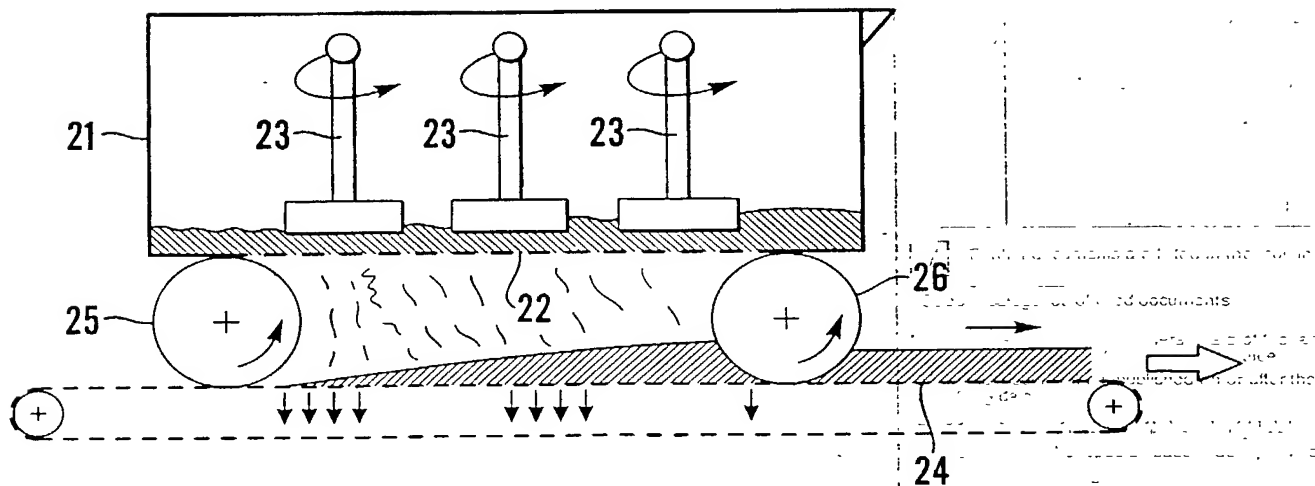


Fig. 2

COMBINED DECLARATION FOR PATENT
APPLICATION AND POWER OF ATTORNEY
(Includes Reference to PCT International Applications)

ATTORNEY'S DOCKET NUMBER
2308/300

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

FILTRATION MEDIA AND THE MANUFACTURE THEREOF

the specification of which (check only one item below):

- ☐ is attached hereto.
- ☐ was filed as U.S. Patent Application Serial No. _____ on _____ and was amended on _____ (if applicable).
- ☒ was filed as PCT International Application Number PCT/GB00/03538 on September 14, 2000 and assigned U.S. Patent Application Serial No. 10/088,152.

I hereby state that I have reviewed and understand the contents of the above-identified specifications, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the patentability of this application in accordance with Title 37, Code of Federal Regulations, § 1.56(a).

I hereby claim priority benefits under Title 35, United States Code, § 119 of any application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States listed below and have also identified below any application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed:

PRIOR APPLICATION(S) AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. 119:

COUNTRY (IF PCT, indicate "PCT")	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 35 USC 119
Great Britain	GB 9921534.5	14 September 1999	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO
			<input type="checkbox"/> YES <input type="checkbox"/> NO
			<input type="checkbox"/> YES <input type="checkbox"/> NO
			<input type="checkbox"/> YES <input type="checkbox"/> NO
			<input type="checkbox"/> YES <input type="checkbox"/> NO
			<input type="checkbox"/> YES <input type="checkbox"/> NO
			<input type="checkbox"/> YES <input type="checkbox"/> NO
			<input type="checkbox"/> YES <input type="checkbox"/> NO

**COMBINED DECLARATION FOR PATENT
APPLICATION AND POWER OF ATTORNEY (Continued)**
(Includes Reference to PCT International Applications)

ATTORNEY'S DOCKET NUMBER

2308/500

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, § 1.56(a) which occurred between the filing date of the prior application(s) and the national or PCT International filing date of this application:

PRIOR U.S. APPLICATIONS OR PCT INTERNATIONAL APPLICATIONS DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C. 120:

U.S. APPLICATIONS			STATUS (Check One)		
U.S. APPLICATION NUMBER	U.S. FILING DATE		PATENTED	PENDING	ABANDONED
PCT APPLICATIONS DESIGNATING THE U.S.					
PCT APPLICATION NO.	PCT FILING DATE	U.S. SERIAL NUMBERS ASSIGNED (if any)			
PCT/GB00/03538	14 September 2000			X	

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. **Michael L. Goldman, Registration No. 30,727; Joseph M. Noto, Registration No. 32,163; Gunnar G. Leinberg, Registration No. 35,584; Edwin V. Merkel, Registration No. 40,087; Georgia Evans, Registration No. 44,597; Alice Y. Choi, Registration No. 45,758; Andrew K. Gonsalves, Registration No. 48,145; Noreen L. Connolly, Registration No. 48,987; John Campa, Registration No. 49,014**

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

SIGNATURE OF INVENTOR 201 <i>Stephen Russell</i>	SIGNATURE OF INVENTOR 202 <i>E Hampshire</i>	SIGNATURE OF INVENTOR 203 <i>M Rathod</i>
DATE <u>28/6/02</u>	DATE <u>29/06/02</u>	DATE <u>28/6/02</u>